Attorney Docket No. SAM-162 PATENT

CERTIFICATE OF MAILING

37 C.F.R. § 1.10 "Express Mail" Mailing Label Number EL675533035US

I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to

Commissioner for Patents, Washington, DC 20231.

Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to BOX PATENT APPLICATION, Assistant

### IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

**BOX PATENT APPLICATION Assistant Commissioner for Patents** Washington, D.C. 20231

### NEW APPLICATION TRANSMITTAL

Transmitted herewith for filing is the patent application of

For (title):

Jang-Ho Cho

Inventor(s):

BRANCH PREDICTOR USING BRANCH PREDICTION ACCURACY

HISTORY

1. Type of Application This new application is for

a(n)

$\boxtimes$	Original	(nonprovisional)
~	Ongmai	THORDFOVISIONALI

□ j	Design	1
-----	--------	---

☐ Plant

☐ Divisional.

☐ Continuation.

☐ Continuation-in-part (C-I-P).

### **Benefit of Prior Application(s)**

The new application being transmitted claims the benefit of prior Korean application(s) nos. 99-45786. See item 7.

### 3. Papers Enclosed

8 Pages of specification
2 Pages of claims
Page of Abstract
2 Sheets of drawings ⊠ formal
☐ informal
Page of Cover Sheet

The enclosed drawing(s) are photograph(s), and there is also attached a "PETITION TO ACCEPT PHOTOGRAPH(S) AS DRAWING(S)." 37 C.F.R. 1.84(b).

### Additional papers enclosed

Preliminary Amendment



Page 1 of 5

		Info	rmation l	Disclosure Statement (37 C.F.R. 1.98)
		Forn	n PTO-14	149 (PTO/SB/08A and 08B)
		Copi	ies of cite	ed references
		Decl	aration o	f Biological Deposit
		Subr	mission o	f "Sequence Listing," computer readable copy and/or amendment pertaining thereto for y invention containing nucleoticle and/or amino acid sequence.
		Aut	horizatio	n of Attorney(s) to Accept and Follow Instructions from Representative
		Spe	cial Com	ments
	$\boxtimes$	Oth	er: Retur	n Postcard.
5.	Dec	larati	ion or oa	th
	$\boxtimes$	Enc	closed	
			Unexec	uted
		$\boxtimes$	Execute	ed by
			$\boxtimes$	inventors
				legal representative of inventor(s). 37 CFR 1.42 or 1.43.
				joint inventor or person showing a proprietary interest on behalf of inventor who refused to sign or cannot be reached.
				This is the petition required by 37 CFR 1.47 and the statement required by 37 CFR 1.47 is also attached. See item 12 below for fee.
		No	t Enclose	rd
			plication entor(s).	is made by a person authorized under 37 C.F.R. 1.41 (c) on behalf of all the above named
				Showing that the filing is authorized.
6.	Assi	gnme	nt	
	×			ent of the invention to Samsung Electronics Co., Ltd.
		⊠	is attacl ACCO will fo	hed. A separate T "COVER SHEET FOR ASSIGNMENT (DOCUMENT) MPANYING NEW PATENT APPLICATION" or FORM PTO 1595 is also attached.  solution.

### 7. Certified Copy

Certified copy(ies) of application(s)

Korea Country	99-45786 Appln. no.	21 October 1999 Filed	-
Country	Appln. no.	Filed	<del></del>
Country	Appln. no.	Filed	

from which priority is claimed

is (are) attached.

☐ will follow.

### 8. Fee Calculation (37 C.F.R. 1.16)

		CLAIMS AS FILED		
	Number filed	Number Extra	Rate	Basic Fee 37 C.F.R. 1.16(a) \$710.00
Total Claims (37 CFR 1.16(c))	8 - 20	0	\$18.00	0
Independent Claims (37 CFR 1.16(b))	1 - 3	0	\$80.00	0
Multiple dependent claim if any (37 CFR 1.16(d))				

- ☐ A Preliminary Amendment canceling claims is enclosed. The filing fee is calculated based on the number of claims remaining after entry of the Preliminary Amendment.
- $\square$  Amendment deleting multiple-dependencies is enclosed.
- ☐ Fee for extra claims is not being paid at this time.

Filing Fee Calculation

\$ 710.00

9.	Sm			tatement(s)					
					at this is a filing by a sma				
			tatus	as a small entity v	vas claimed in prior applic	cation	d	, filed on	
					ing claimed for this application	cation und	uer:		
		35 (	U.S.C	• • •					
				☐ 120,					
				☐ <sub>121,</sub>					
		المسم	طم نطار د	☐ 365(c),	entity is still proper and de	esired.			
		and	WIIICII	status as a siliali	chitty is still propor and as	oon ou.			
				☐ A copy of	the verified statement in t	he prior a	application is	included.	
				Fili	ng Fee Calculation (50%	of A, B	or C above)		
					\$ <u>355.00</u>				
10	).	Fee	Payn	nent Being Made	at This Time				
			Not	Enclosed					
			No f	iling fee is to be parties and the surce	oaid at this time.  harge required by 3 7 C. 1	F.R. 1.16(	(e) can be pa	id subseque	ntly.)
		$\boxtimes$	Enc	losed					
			×	Basic filing fee			\$ <u>710.00</u>		
				Recording assign					
			(See	0.00; 37 C.F.R. 1 e attached "COVE COMPANYING I	R SHEET FOR ASSIGN NEW APPLICATION".)	MENT	\$ <u>40.00</u>	)	
					Total fees enclosed		\$ <u>750.00</u>	·	
1	1.	Met	hod o	f Payment of Fee	S				
			×	Checks in the am	nounts of \$ <u>710.00, 40.00</u>	)	_		
			□ A	Charge Account I duplicate of this t	No. 19-0079 in the amour transmittal is attached.	nt of		\$	

## 12. Authorization to Charge Additional Fees

$\boxtimes$	The Commissioner is hereby authorized to charge the following additional fees during the entire pendency
	of this application to Account No. 19-0079.

- **☒** 37 C.F.R. 1.16(a), (f) or (g) (filing fees)
- ☑ 37 C.F.R. 1.16(b), (c) and (d) (presentation of extra claims)
- 37 C.F.R. 1. 16(e) (surcharge for filing the basic filing fee and/or declaration on a date later than the filing date of the application)
- ☐ 37 C.F.R. 1.17 (application processing fees)
- ☐ 37 C.F.R. 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 C.F.R. 1.311(b))

### 13. Instructions as to Overpayment

- ☑ Credit Account No. 19-0079
- □ Refund

Date: / Columbia | De Columbia

Boston, MA 02110

Telephone: (617) 426-9180, Ext. 149

Facsimile: (617) 426-2275

K:\Samsung\162\pattransltr.wpd

Respectfully submitted,

Steven M. Mills

Registration Number 36,610 Attorney for Applicant

### IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s):

Jang-Ho Cho

Filing Date:

Herewith

Title:

Branch Predictor Using Branch Prediction Accuracy History

### CERTIFICATE OF MAILING UNDER 37 C.F.R.§ 1.10

"Express Mail" Mailing Label Number <u>EL675533035US</u> I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated below and is addressed to BOX PATENT APPLICATION, Assistant Commissioner for Patents, Washington, DC 20231.

00120,2000

Date '

Lizabeth M. Sumner

### **BOX PATENT APPLICATION**

Assistant Commissioner for Patents

Washington, DC 20231

### TRANSMITTAL LETTER

Sir:

Enclosed herewith for filing in the above-identified patent application please find the following listed items:

- 1. New Application Transmittal;
- 2. New Patent Application;
- 3. Executed Declaration, Petition and Power of Attorney;
- 4. Two (2) Sheets of Formal Drawings;
- 5. Certified Copy of Priority Document Korean Application No 99-45786;
- 6. Check in the amount of \$710.00 to cover requisite fee;
- 7. Assignment Recordation Form Cover Sheet - PTO-1595;
- 8. Executed Assignment;
- 9. Check in the amount of \$40.00 to cover assignment recordation fee; and
- 10. Return Postcard.

In connection with the foregoing matter, please charge any additional fees which may be due, or credit any overpayment, to Deposit Account Number 19-0079. <u>A duplicate copy of this letter is provided for this purpose</u>.

Samuels, Gauthier & Stevens, LLP 225 Franklin Street, Suite 3300

Boston, MA 02110

Telephone: (617) 426-9180, Ext. 149

Facsimile: (617) 426-2275

K:\Samsung\162\transapp.wpd

Respectfully submitted,

Steven M. Mills

Registration Number 36,610

Attorney for Applicant

25

5

10

### BRANCH PREDICTOR USING BRANCH PREDICTION ACCURACY HISTORY

This application relies for priority upon Korean Patent Application No. 1999-45786, filed on October 21, 1999, the contents of which are herein incorporated by reference in their entirety.

### Field of the Invention

The present invention relates to the field of computer system, and more particularly to a branch predictor using branch prediction accuracy history and efficient processing techniques for instruction streams which include conditional program flow instructions, such as branch instructions.

### Background of the Invention

Many microprocessors employ a technique known as hardware pipelining to increase instruction throughput by processing several instructions through different phases of execution concurrently. To maximize instruction execution efficiency, it is desirable to keep the instruction execution pipeline full (with an instruction being processed in each pipeline stage) as often as possible such that the pipeline produces useful output every clock cycle. However, whenever there has been a transfer of program flow control to another section of software code and instructions have been speculatively fetched and processed and it is determined that these instructions should not have been executed, the output from the pipeline is not useful.

Exceptions and program flow control instructions such as branch instructions provide examples of how the program flow control can be changed. Branch instructions, which may be conditional or unconditional and may transfer program flow control to a preceding or subsequent code section, are used for frequently encountered situations where a change in program flow control is desired.

A conditional branch instruction determines instruction flow based on the resolution of a specified condition. If A>B then branch to instruction X is an example of a conditional branch instruction. In this case, if A>B, program flow control branches to a code section beginning with instruction X, also referred to as the target code section. If A is not greater than B, the

5

10

instructions sequentially following the branch instruction in the program flow, referred to as the sequential code section, are executed. In executing such conditional branch instruction, it is required to check a condition of the branch instruction for determining the next instruction. Thus, performance of a microprocessor including a central processing unit (CPU) may be adversely affected in pipeline procedures of the microprocessor requiring fast instruction fetch.

To solve the aforementioned problem, many microprocessors adopt a branch predictor (or a branch prediction logic), which operates to predict the outcome of a branch instruction before identifying a condition check of the branch instruction, based on a predetermined branch prediction approach. Thus, instructions are then speculatively fetched from either the target code section or the sequential code section based on the prediction indicated by the branch predictor. Therefore, a pipeline stall can be prevented. However, when a branch prediction is missed, many instructions from the incorrect code section may be in various stages of processing in the instruction execution pipeline. On encountering such a misprediction, instructions following the mispredicted conditional branch instruction in the pipeline (or multiple pipelines) are flushed, and instructions from the other correct code section are fetched. Flushing the pipeline creates bubbles or gaps in the pipeline. Several clock cycles may be required before the next useful instruction completes execution, and before the instruction execution pipeline produces useful output. Such an incorrect guess causes the pipeline to stall until it is refilled with valid instructions. This delay is called the mispredicted branch penalty.

To reduce above described misprediction ratio, various kinds of branch predictors are used. Among the branch predictors, a two-level branch predictor is likely to become more common. A P6 processor of Intel Corporation is the first to use a two-level branch algorithm to improve accuracy. This algorithm, first published by Tse-Yu Yeh and Yale Patt, has the potential to push accuracy well beyond the 90% level achieved by the best processors today.

**Fig. 1** is a schematic diagram for illustrating a structure of a conventional two-level branch predictor. For example, the branch predictor is illustrated in Fig. 2 of *New Algorithm Improves Branch Prediction* by Linley Gwennap, March 27, 1995, MOCROPROCESSOR, pp. 17-21.

Referring to Fig. 1, the two-level branch predictor is composed of a branch history

25

10

register (BHR) 10 and a pattern history table (PHT) 20. The branch history register 10 is used for recording the actions of the most recent k conditional branches. For example, a 1 stored in the branch history register 10 may denote a branch taken, and a 0 stored in the branch history register 10 may denote a branch not taken, respectively. The performed k conditional branches are called a pattern.

The pattern history table 20 is used for recording a pattern history bit Sc, which is used for predicting a conditional branch of a branch instruction to be performed in response to each pattern. For example, the two-level branch predictor predicts a conditional branch I(Sc) in response to an entry of 10 stored in the pattern history table 20. The entry corresponds with a pattern 111010 stored in the branch history register 10. According to the predicted conditional branch I(Sc), the next instruction to the branch instruction is fetched. Referring to the Gwennap paper referenced above, a predicted conditional branch I(Sc) is determined by a most significant bit (MSB) of a pattern history bit Sc stored in the pattern history table 20.

For example, on the assumption that a real conditional branch of the branch instruction is **Rc**, if a predicted conditional branch **I(Sc)** is different from the real conditional branch **Rc**, this case is called a prediction miss. In this case, execution of instructions following the mispredicted conditional branch **I(Sc)** are withdrawn.

According to the real conditional branch **Rc**, both data of the branch history register **10** and the pattern history bit **Sc** stored in the pattern history table **20** are changed. This process is described as follows. When a least significant bit (LSB) corresponding to the real conditional branch **Rc** of the branch instruction is stored to the branch history register **10**, the remaining bits are shifted to the left. At this time, the pattern history bit **Sc** stored in the pattern history table **20** is updated in response to the real conditional branch **Rc**. For example, if the real conditional branch **Rc** is 1 denoting predict taken, the pattern history bit **Sc** is increased by 1, and if the real conditional branch **Rc** is 0 denoting predict not taken, the pattern history bit **Sc** is decreased by 1. The pattern history bit **Sc** can be composed of an up/down saturating counter as shown in *A Study of Branch Prediction Strategies*, by J. Smith, May 1981, pp. 135-148. The saturating counter maintains a minimal value of a pattern history bit **Sc** when the pattern history bit **Sc** is the minimal value, although the real conditional branch **Rc** is 0 denoting not taken. In

10

addition, the saturating counter maintains a maximum value of a pattern history bit  $\mathbf{Sc}$  when the pattern history bit  $\mathbf{Sc}$  is the maximum value, although the real conditional branch  $\mathbf{Rc}$  is 1 denoting taken.

Although branch prediction accuracy may be improved or turned by using different branch prediction algorithms, mispredictions still occur. By the time a misprediction is identified, many instructions from the incorrect code section may be in various stages of processing in the instruction execution pipeline.

An example of a solution to the forgoing performance penalty relevant to mispredicting is disclosed in U.S. Pat. No. 5,860,017 to Sharangpani et al., issued on Jan. 12, 1999, entitled, "Processor and Method for Speculatively Executing Instructions from Multiple Instruction Streams Indicated by a Branch Instruction," which identifies branch instructions, which in relationship to other conditional branch instructions, have a relatively high likelihood of being mispredicted. In this case, once a condition in a branch instruction is identified as being unlikely to be predicted accurately, the processor fetches and decodes instructions from both target and sequential instruction streams indicated by the conditional branch instruction. However, the method proposed by Sharangpani et al. may cause performance deterioration by a resource conflict and may lead to high hardware cost, since the processor fetches both target and sequential instruction streams. Therefore, there is a need for a branch predictor capable of efficient processing of branch instructions by reducing prediction miss with a comparatively simple circuit configuration and low hardware cost.

### Summary of the Invention

It is therefore an object of the present invention to provide a branch predictor capable of efficiently processing branch instructions by reducing prediction misses with a comparatively simple circuit configuration and low hardware cost.

According to an aspect of the present invention, there is provided a branch predictor which includes branch prediction means for predicting a conditional branch of a branch instruction. A comparator generates a comparison signal by comparing the predicted conditional branch from the branch prediction means with a real conditional branch of the branch instruction.

25

10

An accuracy history table stores an accuracy history of the predicted conditional branch. A first state transition logic generates an accuracy history bit to be stored to the accuracy history table in response to the comparison signal. A multiplexer outputs either the conditional branch or an inverted conditional branch as a final branch prediction outcome, in response to a predicted accuracy history signal based on the accuracy history bit.

### Brief Description of the Drawings

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of preferred embodiments of the invention, as illustrated in the accompanying drawings in which like reference characters refer to the same parts throughout the different views. The drawings are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention.

Fig. 1 is a schematic diagram illustrating a structure of a conventional two-level branch predictor.

Fig. 2 is a schematic diagram illustrating a structure of one embodiment of a two-level branch predictor according to the present invention.

### Description of the Preferred Embodiment

In accordance with the invention, a branch predictor outputs either a predicted conditional branch or an inverted predicted conditional branch as a final branch prediction outcome, in response to a predicted accuracy history signal based on an accuracy history bit. According to the accuracy history bit, it is determined whether the branch prediction outcome of the branch predictor is correct. If the predicted conditional branch is correct, the branch predictor outputs the predicted conditional branch, and if the predicted conditional branch is not correct, the branch predictor outputs the inverted predicted conditional branch, in response to the predicted accuracy history signal.

Fig. 2 is a schematic diagram illustrating a structure of one embodiment of a two-level branch predictor according to the present invention. Referring to Fig. 2, the two-level branch predictor comprises a branch history register 15 for recording actions of the most recent k

25

5

10

conditional branches, a pattern history table 25 for recording a pattern history bit Sc used for generating a predicted conditional branch I(Sc), and an accuracy history table 60 for recording accuracy history of the predicted conditional branch I(Sc). The accuracy history table 60 is composed of a memory array.

A first state transition logic circuit 30 generating a pattern history bit Sc to be stored to the pattern history table 25 in response to a real conditional branch Rc is coupled to the pattern history table 25. In addition, a second state transition logic circuit 50 generating an accuracy history bit Ac to be stored to the accuracy history table 60.

Further, the branch predictor according to the present invention comprises a comparator 40 generating a comparison signal by comparing the predicted conditional branch I(Sc) generated by the pattern history bit Sc with the real conditional branch Rc of the branch instruction. The comparison signal is inputted to the second state transition logic circuit 50 to generate the accuracy history bit Ac. In addition, the branch predictor comprises a multiplexer 70 selecting either a predicted conditional branch I(Sc) or an inverted predicted conditional branch as a final branch prediction outcome or result. A predicted accuracy history signal I(Ac) based on the accuracy history bit Ac is used as a selection signal for the multiplexer 70. Operation of the branch predictor is described as follows.

A predicted conditional branch **I(Sc)** is generated in response to a pattern history bit **Sc** corresponding to a pattern stored in the branch history register **15**. The predicted conditional branch **I(Sc)** is inputted to the comparator **40** to be compared with a real conditional branch **Rc**.

The real conditional branch  $\mathbf{Rc}$  has a 1 or 0 value according to "predict taken" or "predict not taken," respectively, and the value stored in the branch history register 15 is updated in response to the value of the real conditional branch  $\mathbf{Rc}$ . According to the updated value of the branch history register 15, the pattern history bit  $\mathbf{Sc}$  is updated. The first state transition logic circuit 30 updates the pattern history bit  $\mathbf{Sc}$ . The first state transition logic circuit 30 is composed of an up/down saturating counter. In the first state transition logic circuit 30, the value of the pattern history bit  $\mathbf{Sc}$  is increased by 1 when the real conditional branch  $\mathbf{Rc}$  is 1 (i.e., taken), and the value of the pattern history bit  $\mathbf{Sc}$  is decreased by 1 when the real conditional branch  $\mathbf{Rc}$  is 0

25

10

(i.e., not taken).

The predicted conditional branch I(Sc) has a value of 1 or 0 in response to a most significant bit (MSB) of the pattern history bit Sc. The comparator 40 outputs 1 or 0 as a comparison signal to the second state transition logic circuit 50 by comparing the real conditional branch Rc and the predicted conditional branch I(Sc). For example, if the predicted conditional branch I(Sc) is the same as the real conditional branch Rc, the comparator 40 outputs 1, and if the predicted conditional branch I(Sc) is different from the real conditional branch Rc, the comparator 40 outputs 0.

The second state transition logic circuit **50** receiving the comparison signal determines an accuracy history bit **Ac** to be stored to the accuracy history table **60** in response to the comparison signal. The second state transition logic circuit **50** is composed of an up/down saturating counter increasing the value of the accuracy history bit **Ac** by 1 when the predicted conditional branch **I(Sc)** is the same as the real conditional branch **Rc**, and decreasing the value of the accuracy history bit **Ac** by 1 when the predicted conditional branch **I(Sc)** is different from the real conditional branch **Rc**. The accuracy history bit **Ac** can be used after learning a branch accuracy of the corresponding pattern by monitoring the pattern.

According to the above described method, the accuracy history bit **Ac** is determined and stored to the accuracy history table **60**. According to the accuracy history bit **Ac**, it can be determined whether a prediction result of the branch predictor is correct. For example, if a pattern history bit **Sc** is 011 corresponding to a pattern 11 10 stored in the branch history register **15**, a predicted accuracy history signal **I(Ac)** is generated by an MSB of the accuracy history bit **Ac**. The predicted accuracy history signal **I(Ac)** is used for determining whether the predicted conditional branch **I(Sc)** is correct. For example, if it is considered as the predicted conditional branch **I(Sc)** is correct, the predicted accuracy history signal **I(Ac)** having a value of 1 is outputted to the multiplexer **70**. Thus, the predicted conditional branch **I(Sc)** is outputted from the multiplexer **70** as a final prediction result. In addition, if it is considered as the predicted conditional branch **I(Sc)** is not correct, the predicted accuracy history signal **I(Ac)** having a value of 0 is outputted to the multiplexer **70**. Thus, the inverted predicted conditional branch is outputted from the multiplexer **70** as a final prediction result. As described above, the predicted

10

accuracy history signal **I**(**Ac**) is used as a selection signal of the multiplexer **70** selecting either the predicted conditional branch **I**(**Sc**) or an inverted predicted conditional branch as a final prediction outcome of the branch predictor.

As described above, the branch predictor according to the present invention outputs either a predicted conditional branch or an inverted predicted conditional branch as a final branch prediction outcome, in response to a predicted accuracy history signal based on an accuracy history bit, so that the two-level branch predictor can reduce the misprediction and a microprocessor can process branch instructions more efficiently. In this case, the branch prediction according to the present invention merely appends the accuracy history table **60** and multiplexer **70** to the conventional branch predictor. Thus, the branch prediction according to the present invention can reduce the misprediction with relatively simple circuitry and low hardware cost.

While this invention has been particularly shown and described with references to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the following claims.

What is claimed is:

### **CLAIMS**

	1.	Α	branch	predictor	comprising
--	----	---	--------	-----------	------------

branch prediction means for predicting a conditional branch of a branch instruction; a comparator for generating a comparison signal by comparing the predicted conditional branch from the branch prediction means with a real conditional branch of the branch instruction; an accuracy history table for storing an accuracy history of the predicted conditional branch;

a first state transition logic circuit for generating an accuracy history bit to be stored to the accuracy history table in response to the comparison signal; and

a multiplexer for outputting an alternative one of the conditional branch and an inverted conditional branch as a final branch prediction outcome, in response to a predicted accuracy history signal based on the accuracy history bit.

2. The branch predictor according to claim 1, wherein the branch prediction means comprises:

a branch history register for storing conditional branches of previous branch instructions;

a pattern history table for storing pattern history bits used for generating the predicted conditional branch corresponding to the conditional branches of the previous branch instructions stored in the branch history register; and

a second state transition logic circuit for generating the pattern history bits in response to the real conditional branch of the branch instruction.

- 3. The branch predictor according to claim 2, wherein the second state transition logic circuit includes an up/down saturating counter.
- 4. The branch predictor according to claim 1, wherein the accuracy history table includes a memory array.

15

20

25

5

10

- 5. The branch predictor according to claim 1, wherein the comparator generates the comparison signal having a first logic value when the predicted conditional branch is the same as the real conditional branch, and generates the comparison signal having a second logic value when the predicted conditional branch is different from the real conditional branch.
- 6. The branch predictor according to claim 1, wherein the first state transition logic circuit includes an up/down saturating counter.
- 7. The branch predictor according to claim 6, wherein the first state transition logic circuit is used after learning the predicted branch accuracy of patterns of previous branch instructions.
  - 8. The branch predictor according to claim 1, wherein the predicted accuracy signal is determined by a most significant bit of the accuracy history bit.

10

15

# BRANCH PREDICTOR USING BRANCH PREDICTION ACCURACY HISTORY

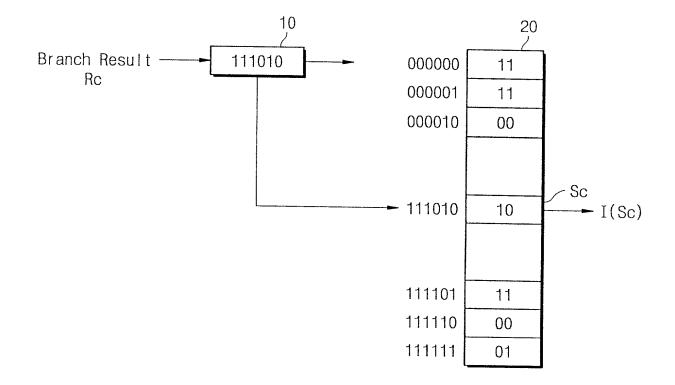
### Abstract of the Disclosure

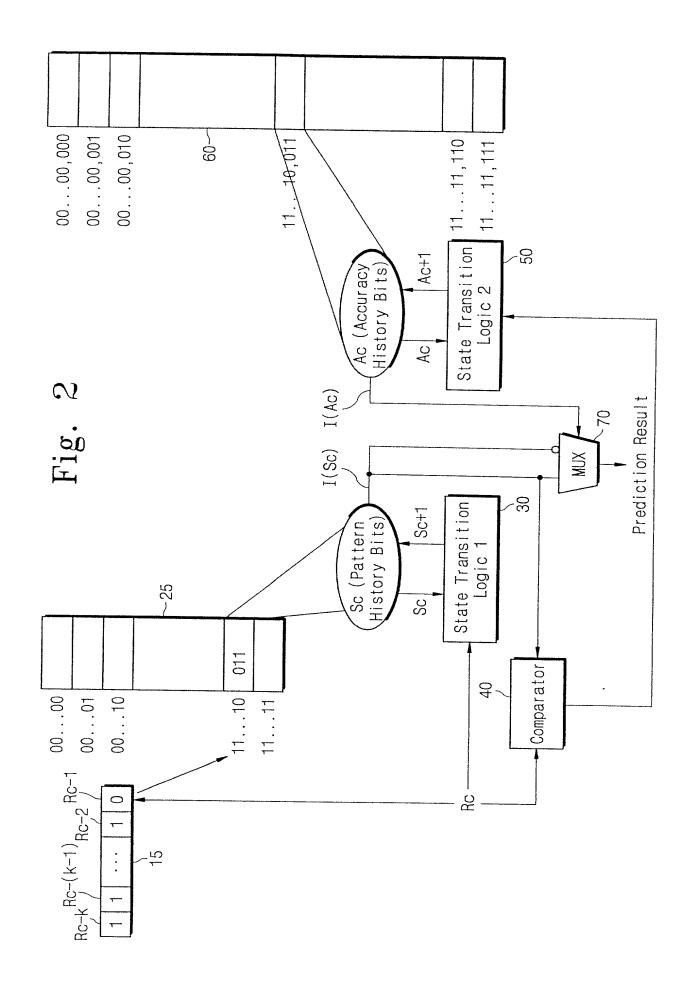
A branch predictor outputs either a predicted conditional branch or an inverted predicted conditional branch as a final branch prediction outcome, in response to a predicted accuracy history signal based on an accuracy history bit. According to the accuracy history bit, it is determined whether the branch prediction outcome of the branch predictor is correct. If the predicted conditional branch is correct, the branch predictor outputs the predicted conditional branch, and if the predicted conditional branch is not correct, the branch predictor outputs the inverted predicted conditional branch, in response to the predicted accuracy history signal. For performing this process, the branch prediction appends an accuracy history table and a multiplexer to a conventional branch predictor, so that the branch prediction according to the present invention can reduce the misprediction with relatively simple circuitry and low hardware cost.

K:\Samsung\162\162patapp2.wpd

Fig. 1

(Prior Art)





10-001 (8 14:25 FPOM:HANA PAT SEDUL

34537635

TO: 031 209 6054 FAX NO. 8174282275

PAGE: 002 P. 18/32

DCT-17-2000 TUE 05:34 PM SAMUELS GAUTHIER STEVENS

Allowery Doubel No: DECLARATION, PRITTION AND POWER OF ATTORNEY FOR 8AM-162 PATENT APPLICATION As a below named invertor, I hereby declare that: My residence, post office sidence and citizenship are as stated below next to my name, I believe I am the original, first and sole inventor (if only one name is tisted below) or an original, first and joint inventor (If plant manes are listed below) of the subject matter which is claimed and fire which a patent is sought on the invention entitled: Branch Predictor Uning Branch Prediction Accuracy History the specification of which (check only one): is attached hereto. Was filed an United States Patent Applications Sertal No. DINKRIE BEW DIE (if upplicable) was filed as PCT Patent Application Seriai No. and was assended under PCT Article 19 (if upplicable) I hereby state that I have reviewed and understand the conforts of the specification, including the plants as amended by any amondinest softward to havein. I seknowledge the dury in disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56. I hereby claim foreign priority benefits under Title 35, United States Code, \$119 of any fereign application(a) for potent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for putent (if inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed: PRIOR PORRIGNOST APPLICATIONS AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. | 115 PRIORITY CLAIMED UNDER COUNTRY DATE OF FILING APPLICATION NUMBER 35 U.S.C. § 119 (YES/NO) (If PCT indicate PCT) (day, month, year) 99-45786 21 (3ctober 1999 Remitikasi Koros

in and a

17

'nj

ļ

N

M-OCT-19 14:25 FROM: HAND PAT SECUL

The state of

#

The state state street street

34537635

TO:031 209 6054

PAGE: 983 P. 17/32

OCT-17-2000 TUE 05:34 PN SAMUELS CAUTHIER STEVENS

FAX NO. 8174282275

Ibereby claim the benefit under Title 35, United States Code, § 1396) of any United Seases provisional applications(a)		A A	APPLICATION	TORNEY POR PATENT	Atterney Docket No: SAM-162
TRIOR U.S. APPLICATIONS FOR BENEETT UNDER 39 U.S.C. § 120 of the United States applications of the Control of t	I hereby clais Sated below.	n the bundfit under	Title 35, United Stat	tes Code, § 1 19(e) of any United	Summ provisional application(s)
I hereby claim the benefit under Title 35, United States Code, § 120 of any United States applications) designating the United States of America that is an listen listed below and, transfer as the subject metre of each of the claims of this application is not disclosed in morbitors price applications; the mentals provided by the first puregraph of Title 37, United States of America that is an interface provided by the first puregraph of Title 37, United States Code, § 112, lephonyledge the dwby to disclose mentals information as defined in Title 37, Code of Foderal Regislations, § 1.59 which occurred herween the miling date of the price applications and the automate of PCT international filling due of the price applications and the automate of PCT international filling due of this applications are miling date of PCT international filling due of this applications.  PRICE U.S. APPLICATION NUMBER OF CT INTERNATIONAL APPLICATION(8) DESIGNATING THE U.S. POR BENEFIT UNIONS OR PCT INTERNATIONAL APPLICATION(8) DESIGNATING THE U.S. POR BENEFIT UNIONS OR PCT INTERNATIONAL APPLICATION(8) DESIGNATING THE U.S. POWER (1FCT Indicate PCT)  POWER OF ATTORNEY: As a second inventor, (hereby appetent the following strongers and/or agents to procedule this application and transact all business in the Patent and Trademark Utilice connected therewith.  Mauntor E. Guschler Reg. No. 20, 209 Price J. J. State Reg. No. 35,965 Reg. No. 24,445 Arises J. Fowers Reg. No. 35,610 Reg. No. 24,445 Arises J. Fowers Reg. No. 35,610 Reg. No. 35,610 Reg. No. 35,610 Reg. No. 35,965 Reg. No. 35,192 Sound Correspondence to  Unicet Telephorus Calls to:  Seven M. Mills, Esq. (617) 426-2275 (the samile)  Whistories de Stavens L.LP (617) 426-2275 (the samile)  Whistories de Stavens L.LP (617) 426-2275 (the samile)  I hereby steadage due in the letters potent be greened to run few the invented or of inconvery described and claims and to the foregains declaims and belief are believed to be true; and farther that these reterments were made with the horoviced			H FOR BENEFIT	UNDER 35 U.S.C. \$ 119(e):	
international applicationals) designating the United States of Armerica that differ these price applications are the ability of the Calesto of this application is float these price applications of the Calesto of the States Code, § 112, it acknowledge the duty to discloss states the price applications and first puragraph of Title 32, United States Code, § 112, it acknowledge the duty to discloss states in the price of the price applications and the national or PCT international filling date of this application:  PRICE U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATION(8) DESIGNATING THE U.S. FOR BENEFIT UNDER AS U.S.C. § 128.  APPLICATION MUMBER  (If PCT Indicate PCT)  DATE OF FILING  (Idy, mayth, year)  GR ABANDONED)  POWER OF ATTORNEY: As a named inventor, I hereby appetent the following attorneys and/or agents to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.  Maurice E. Geschier  Rog. No. 20,798  First J. U'Shea  Rog. No. 35,805  Mullians R. Hillen  Rog. No. 36,445  Arisens J. Powers  Rog. No. 35,810  Sould Correspondence to:  Sieven M. Mills, Baq.  Seven M. Mills, Baq.  Seven M. Mills, Baq.  (617) 426-2275 (Thesizable)  Whenford I petition that letters peters be grassed to one that the invention of discovery described and claimed in the attached specification and claims, and hereby subscribe my name to said specification and claims and to the foregoing declaration, power of ettorney, and this peritano.  I hereby declare that all attachments unde herein of my owns knowledge are less and that all attachments made no information and bellet are believed to be true; and during that these subscribes are less and that all attachments made with the knowledge that willful false attached to be true; and there are the mileston made with the knowledge that willful false attached to be true; and there are no peritanology in a peritanology of the spillonters or any patent instant decrease.  Signature  James Low Code of the United States Code and there are not					FILING DATE
international applicationals) designating the United States of Armerica that differ these price applications are the ability of the Calesto of this application is float these price applications of the Calesto of the States Code, § 112, it acknowledge the duty to discloss states the price applications and first puragraph of Title 32, United States Code, § 112, it acknowledge the duty to discloss states in the price of the price applications and the national or PCT international filling date of this application:  PRICE U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATION(8) DESIGNATING THE U.S. FOR BENEFIT UNDER AS U.S.C. § 128.  APPLICATION MUMBER  (If PCT Indicate PCT)  DATE OF FILING  (Idy, mayth, year)  GR ABANDONED)  POWER OF ATTORNEY: As a named inventor, I hereby appetent the following attorneys and/or agents to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.  Maurice E. Geschier  Rog. No. 20,798  First J. U'Shea  Rog. No. 35,805  Mullians R. Hillen  Rog. No. 36,445  Arisens J. Powers  Rog. No. 35,810  Sould Correspondence to:  Sieven M. Mills, Baq.  Seven M. Mills, Baq.  Seven M. Mills, Baq.  (617) 426-2275 (Thesizable)  Whenford I petition that letters peters be grassed to one that the invention of discovery described and claimed in the attached specification and claims, and hereby subscribe my name to said specification and claims and to the foregoing declaration, power of ettorney, and this peritano.  I hereby declare that all attachments unde herein of my owns knowledge are less and that all attachments made no information and bellet are believed to be true; and during that these subscribes are less and that all attachments made with the knowledge that willful false attached to be true; and there are the mileston made with the knowledge that willful false attached to be true; and there are no peritanology in a peritanology of the spillonters or any patent instant decrease.  Signature  James Low Code of the United States Code and there are not				`	
APPLICATION NUMBER (If PCT Indicate PCT)  POWER OF ATTORNEY: As a named inventor, ( hereby appeint the following afformers and/or agents to prosecute this application and transact all business in the Patent and Trademark Urice connected therebyth.  Maurice E. Geschler Rog. No. 20,798 Patrick J. O'Shea Rog. No. 35,305 Richard L. Sievens Rog. No. 20,798 Patrick J. O'Shea Rog. No. 35,983 Matthew E. Courous Rog. No. 24,445 Arizon J. Fowers Rog. No. 35,983 Matthew E. Courous Rog. No. 35,192 Androny P. Omello, Fr. Rog. No. 36,610 Pog. No. 36,610 Rog. No. 35,192 Androny P. Omello, Fr. Rog. No. 34,572 Serven M. Mills. Baq. No. 34,572 Matthew E. Courous Rog. No. 35,192 Androny P. Omello, Fr. Rog. No. 34,572 (617) 426-2180 Nat. 149  Steven M. Mills. Baq. Stevens LLP (617) 426-2275 (facalantia)  Wherefore I polition that betters potent be granted to use for the the invention or discovery described and claims and to the foregoing documation, power of externoy, and this position.  I hereby steeless that all attenuantes and hereby subscribe my name to said specification and claims and to the foregoing documation, power of externoy, and this position in the attention and bettle are believed to be true; and further that these estimatoria wate under with the knowledge that willful fines attenuents or both, under Rection 1001 of Title 18 of the United States Code and that see heritable by fine or imprisonment, or both, under Rection 1001 of Title 18 of the United States Code and that see heritable by fine or imprisonment, or both, under Rection 1001 of Title 18 of the United States Code and that see heritable by fine or imprisonment, or both, under Rection 1001 of Title 18 of the United States Code and that see heritable by fine or imprisonment, or both, under Rection 1001 of Title 18 of the United States Code and that see heritable by fine or imprisonment, or both, under Rection 1001 of Title 18 of the United States Code and that see heritable in the code of the political page of the political page of the political page of the	internations aubject matt provided by information the prior ap	t application(s) do or of each of the clu- the first paragraph as defined in Thic plications and the	mignating the United aints of this application in of Tido 35, United a 37, Code of Poders national or PCT into	d States of America that is are un is not disclosed in that/those States Code, § [12, t seknowk il Regulations, § 1.56 which no creational filling date of this ap-	nated percy and, muchas as the price application(s) in the township edge the duty to disclose majorial current between the Ming date of illestion:
CLIPCT Indicate PCI3 (day, munits, year)  POWER OF ATTORNEY: As a named inventor, I havely appelent the following attorneys and/or agents to prosocute this application and transact all business in the Patent and Trademark Cliffor connected therewish.  Maurice E. Geschier Reg. No. 20,798 Patrick J. O'Shea Reg. No. 35,305 Misthrow E. Cottrops Reg. No. 24,445 Ariens J. Powers Reg. No. 35,985 Misthrow E. Cottrops Reg. No. 33,596 Buyen M. Millis Reg. No. 36,610 William R. Bilton Rag. No. 35,192 Androny P. Onallo, Jr. Res. No. 36,872.  Sould Correspondence to:  Sieven M. Mills. Baq. Stevens LLP (617) 426-9180 Rrt. 149 (617) 426-9180 Rrt. 149 (617) 426-9180 Rrt. 149 (617) 426-9275 (floakaille)  Wherefore I polition that betters potent be granted to one for the investion or discovery described and claims and to the foregoing declaration, power of stevency, and this partition.  I hereby stendage that till attenuenchs unade herein of my own browledge are two and that all statements made on information and belief are believed to be true; and further that these statements with the knowledge that willful fifthe statements under the believed to be true; and further that these extensions were under with the knowledge that willful fifthe statements under the believed to be true; and further that these extensions were under with the knowledge that willful fifthe statements under the validaty of the application or any patent issued theretoe.  Signature  James of Post Name Calo  James of Post Name Calo  James of Post Name Calo  James Lowelley and Lowell Research and the statements of the particular that or imprisonment, or both, under Region 1001 of Tale 18 of the United States Code and that such willful fisher statements with the knowledge that willful fisher statements of the validaty of the application or any patent issued theretoe.	PRIOR U.S FOR BENT	s. Applicated Epit under 35	NS OR PCT INTER U.S.C. § 120		
POWER OF ATTORNEY: As a suamed inventor, I hereby appoint the following attorneys and/or agents to prosecute this application and transact all business in the Patent and Trademark Office consected therewish.  Maurice E. Genther Reg. No. 20,798 Patrick J. O'Shea Reg. No. 35,305 Richard L. Stevene Reg. No. 24,445 Arisen J. Forwer Reg. No. 35,983 Matthew P. Countys Pag. No. 23,698 Serven M. Mills Pop. No. 36,610 William R. Hilton Reg. No. 35,192 Androny P. Onallo, Jr. Reg. No. 36,572  Soud Correspondence to  Steven M. Mills, Eaq. Serven M. Mills, Eaq. Genty of Active & Stevens LLP 225 Freshelin Street Boston, Massachments 12110  Wherefore I petition that betters potent be granted to one the the investion or discovery described and claimed in the attached specification and claims, and hereby subscribe my manue to said specification and claims and to the foregoing declaration, power of accorney, and this periclon.  1 hereby declare that all attenuates made herein of my own knowledge are two and that all attenuates made on information and belief are believed to be true; and further that these value with the knowledge that willful filter satisfactured a believed to be true; and further that these value with the knowledge that willful filter satisfactured a belief or the United States Code and that such willful filter autemate, or both, under Rection 1001 of Title 18 of the United States Code and that such willful filter autemate, or both, under Rection 1001 of Title 18 of the United States Code and that such willful filter autemates the validaty of the application or any patent instand therebee.  Signature  James of Politoners and Code Transaction for the period of the States London filter and London for the States London files and London for the States London files.					STATUS: (PATENTED, PENDING OR ABANDONED)
Steven M. Mills, Baq.  Samuels, Gauthier & Stevens LLP  225 Franklin Street  Bosson, Messachusers (12) 10  Wherefore I petition that letters patent be granted to see the the invention or discovery described and claimed in the attached specification and claims, and hereby subscribe my mane to said specification and claims and to the foregoing declaration, power of etternoy, and the patieton.  I hereby declare that all atsignments and herein of my own knowledge are true and that all atterments made on information and belief are helibred to be true; and further that these statements were made with the knowledge that willful filter statements and the like as made are particulable by fine or imprisonment, or both, under Section 1001 of Tate 18 of the United States Code and that such willful filter materials may jouparding the validity of the application or any patent issued fivereon.  Signature  Jate Oct. 20, 2000  Foll Numbe of Patentines	strin mpp/lot	Kigg and transact (	all business in the Pa Rog. No. 20,798	Patrick J. O'Si	Reg. No. 33,305
Samuels, Gautheir & Stevens LLP  225 Franklin Street  Bosson, Massachusers, 11210  Wherefore I petition that letters patent be granted to me for the invention or discovery described and claims and in the attached specification and claims, and hereby subscribe my mante to said specification and claims and to the foregoing declaration, power of etternoy, and this patieton.  I hereby declare that all automosous anado berein of my own knowledge are true and that all enternants made on information and belief are believed to be true; and further that those statements were made with the knowledge that willful film statements and the like so made are punishable by fine or imprisonment, or both, under Scotion 1001 of Tatle 18 of the United States Code and that each willful false sustaments may journative the validity of the application or any patent issued thereon.  Signature  Jane Cho  Jane Dec 200, 2000  Jane Dec 200, 2000	this applies Maurice E. Richard L. Matthew P	tion and transact ( Geathler Sievens L'Couvert	all Business in the Pa Rog, No. 20,798 Rog, No. 24,445 Rog, No. 25,398	Phirick J. O'St Phirick J. O'St Arisms J. Powitt Survey M. Wille	Reg. No. 35,305 Reg. No. 35,983 Reg. No. 36,410
Samuels, Gauthier & Stevens LLP  225 Franklin Street  Boston, Massachusens (12) 10  Wherefore I polition that letters potent be granted to me for the invention or discovery described and claims and in the attached specification and claims, and hereby subscribe my name to said specification and claims and to the foregoing declaration, power of etternoy, and this potent.  I hereby riculate that all statements unade berein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that those statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Scotion 1001 of Take 18 of the United States Code and that each willful false statements may joupardize the validity of the application or any pasmi issued thereon.  Signature  Jane Cho  Jane Doct 20, 2000  Tention Name  Tention Name	this applies Maurice E. Rishard i Matthew F William B.	don and transact ( Gesshier Stevens L. Conneys . Hilton	all Business in the Pa Rog, No. 20,798 Rog, No. 24,445 Rog, No. 25,398	Patrick J. O'Sil Ariens J. Powist Survey M. Wills Anthony P. One	Reg. No. 35,305 Reg. No. 35,983 Reg. No. 36,610 Reg. No. 38,572
Wherefore I petition that letters potent be granted to me the the invention or discovery described and claims and in the attached specification and claims, and hereby subscribe my name to said specification and claims and to the foregoing declaration, power of externey, and the poteton.  I hereby riculate that all attachments and berein of my own knowledge are true and that all attachments made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may joupardize the validity of the application or any patent issued thereon.  Signature  Jane Oct. 20, 2000  Full Name of Tandy Name	Maurice E. Rishard L. Matthew P. William B. Sond Corre	espondence to	all Business in the Pa Rog, No. 20,798 Rog, No. 24,445 Rog, No. 25,398	Patrick J. O'Si Ariene J. Power Survey M. Wille Anthony P. One Direct Tek	Reg. No. 35,305 Reg. No. 35,983 Reg. No. 36,610 Reg. No. 38,572 Reg. No. 38,572 Rhouse Calls to: Mills. Reg.
attached specification and claims, and hereby subscribe my make to said specification and claims and to say foregoing declaration, power of ettorney, and this patieton.  I hereby significant that all attachments and a herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that those statements were made with the knowledge that whitful false statements and the like so made are participable by fine or imprisonment, or both, under Scotion 1001 of Title 18 of the United States Code and that such willful false statements may joupardize the validity of the application or any pasmi issued thereon.  Signature  Jane Mo Cho  Jane Mo Cho	Maurice E. Richard L. Mathow P. William B. Soud Corre	espendence to  Mile, Esq.	all Dusinose in the Pa Rog. No. 20,798 Rog. No. 24,445 Rog. No. 33,298 Rog. No. 35,192	Patrick J. O'Sil Arisma J. Power: Survey M. Pettle Anthony P. One Direct Tek Steven M. (617) 420-	Reg. No. 35,305 Reg. No. 35,983 Reg. No. 36,610 Reg. No. 38,572 Reg. No. 38,572 Reg. No. 38,572 Reg. No. 38,572
Full Name of Tanky Name Process Process Name	Maurice E. Richard L. Mathew F William B.  Soud Corre Steven M. Sanweis, C 225 Frank	cion and transact of Grantiles Sievens Common History	All Dusinose in the Pa Rog, No. 20,798 Rog, No. 24,445 Rog, No. 35,298 Rog, No. 35,192	Patrick J. O'Sil Arisma J. Power: Survey M. Pettle Anthony P. One Direct Tek Steven M. (617) 420-	Reg. No. 35,305 Reg. No. 35,983 Reg. No. 36,610 Reg. No. 38,572 Reg. No. 38,572 Reg. No. 38,572 Reg. No. 38,572
Pull Nume of	Maurice E. Richard L. Matthew E William B.  Sond Corre Steven M. Samuels, C 225 Frank Bosson, M Whatefore attached a foregoing I hereby a informatic willful ful of Title 1	dion and transact of Grantiles Sievens Comora History	Rog. No. 20,798 Rog. No. 24,445 Rog. No. 24,445 Rog. No. 32,298 Rog. No. 35,192  LLP  Control patent be granted plaints, and hereby and the true; and the true; and the true; and the title no made are the title no made are the title no made and that	Patrick J. O'Sil Ariens J. Powers Ariens J. Powers Serven M. Willia Anthony P. One Direct Tele Serven M. (617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(	Reg. No. 35,305 Reg. No. 35,305 Reg. No. 35,983 Reg. No. 36,610 Reg. No. 38,572 Reg. No. 36,610 Reg. No. 38,572 Reg. Reg. No. 38,572 Reg. Reg. Reg. Reg. Reg. Reg. Reg. Reg.
	Maurice E. Richard L. Matthew E William B.  Sond Corre Steven M. Samuels, C 225 Frank Bosson, M Whatefore attached a foregoing I hereby a informatic willful ful of Title 1	dion and transact of Guardier Sievens L. Comova L. Comova L. Hillon  Expendence to  Mills, Baq  Gauthier & Steventin Street  Lasaccusers (12) I  I petition that lett specification and of declaration, power declare that all also on and bellet are b for statements and 8 of the United S in or any patent ist	Rog. No. 20,798 Rog. No. 24,445 Rog. No. 24,445 Rog. No. 35,192 Rog. No. 35,192  there potent be granted claims, and hereby in of etterney, and the clients and hereif clients in made are the like no made are that Code and that made thereon.	Patrick J. O'Sil Ariana J. Powatt Surven M. Mills Anthony P. One Direct Tele Steven M. (617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426-(617) 426	Reg. No. 35,305 Reg. No. 35,965 Reg. No. 36,610 Reg. No. 38,572 Reg. No. 38,572 Robino Calle to:  Mille, Esq. 9180 Nat. 149 2275 (faceimile)  avery described and claimed in the oscification and claims and to the more made with the knowledge that meant, or both, under Section 1001 may jonparding the validity of the

ce-Sawan, Kyanggi-da

J-111, Hembwan Apt., 462, Kewan-long, Kwamma-ke

Residence & Chiamphip

Post Office Address

Republic of Karen

Suven Kynnggi-do